

## Crabs of the Genus *Calappa* from the Ryukyu Islands, with Description of a New Species

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**ABSTRACT**—Nine species of the genus *Calappa* (Crustacea, Decapoda, Calappidae) are recorded from the Ryukyu Islands based on the collections of the University of the Ryukyus. One of them is described as a new species under the name of *C. quadrimaculata*, being readily distinguished from the closest congener, *C. lophos* (Herbst), by having no striped markings on the carapace and chelipeds, and also by the different proportion and armature of the carapace. The new species is also known from Taiwan.

### INTRODUCTION

The crabs of the genus *Calappa* (Family Calappidae) living in shallow-water of the Indo-Pacific and Atlantic Oceans are called the box crabs due to having the thin clypeiform expansion at each posterolateral side of the carapace, and well known by their peculiar habit of breaking the shell by the right chela to eat its soft part or hermit crab living in the empty shell [1, 2].

During the extensive survey of the shallow-water crab fauna of Nakagusuku Bay in southeastern Okinawa-jima Island, the Ryukyu Islands, we encountered five specimens referable to the species close to, but different from *C. lophos* (Herbst) which is one of the commonest *Calappa* species in Japanese waters. On a detailed comparative examination, they were proved to represent a new species which will be described in the present paper under the name of *C. quadrimaculata*, together with records of the known species from the Ryukyu Islands based on the collections of the Department of Marine Sciences, the University of the Ryukyus. During the recent field survey in Taiwan, the senior author found three specimens

of *Calappa* without doubt referable to the new species at the fish market together with *C. lophos* (Herbst) and *C. philargius* (Linnaeus), both of which are very common.

The *Calappa* species attract not only some biologists, but also certain collectors and aquarists, due to the big size and the beautiful coloration with spots and bands in addition to the peculiar shape and ecology. It is generally considered that the census has been made on rather thorough investigations, and thus the present discovery of a new species is remarkable and worth noting.

The bulk of the specimens examined is preserved in the University of the Ryukyus (URM) except for the holotype and one of the paratypes of the new species and a duplicate specimen of each species, which are deposited in the National Science Museum, Tokyo (NSMT). In the measurements of each species, the breadth and length of the carapace are abbreviated to cb and cl, respectively, with the greatest breadth including the clypeiform expansions of both sides.

### SYSTEMATIC ACCOUNT

Family Calappidae

Genus *Calappa* Weber, 1795

*Calappa bicornis* Miers, 1884

OKINAWA. Nakagusuku Bay, 15–20 m

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deep.—1 ♀ (URM-CR 0075; cb 62.5 mm), 9-IX-1985; 1 ♀ (URM-CR 0081; cb 57.8 mm), 1 ♀ (UR M-CR 0082; cb 71.8 mm), 30-VII-1986; 1 ♂ (URM-CR 1103, NSMT-Cr 9620; cb 81.7 mm), 1 ♀ (URM-CR 1104; cb 65.5 mm), 10-VI-1987.

*Remarks.* This species is readily distinguished from *Calappa gallus* (Herbst) by having a tubercular tooth immediately behind the external orbital angle. *C. woodmasoni* Alcock based on a young specimen from off south coast of Sri Lanka was decidedly synonymized with this species by Rathbun [3]. *C. woodmasoni* was, however, resurrected by Ihle [4] who recorded a young female from Manipa Island in the Malay Archipelago. It is well known that the contour of the carapace is remarkably variable during development in the genus *Calappa*, and that the carapace is generally narrower and more quadrangular in the young. Based on the difference in the second peduncular segment of antenna, Ihle [4] distinguished both species, but this character is probably variable just like in the other groups of crabs, e.g., some genera of the family Xanthidae, in which the orbit completely closed by the well developed antennal peduncle is considered as one of the generic criteria, but the orbit is still incomplete, with a wide hiatus, in the young.

This species is known from the Providence Islands (type locality) and the Seychelles in the western Indian Ocean, and from Tosa Bay and several localities around the Kii Peninsula in central Japan. If *C. woodmasoni* is synonymized with this species, the records from Sri Lanka and Manipa Island will become the localities intervening between the western Indian Ocean and Japan.

#### *Calappa calappa* (Linnaeus, 1758)

OKINAWA. Nakagusuku Bay.—1 ♂ (URM-CR 0760; cb 120.2 mm), 1 ♀ (URM-CR 0761; cb 125.0 mm), 15-X-1985; 1 ♂ (URM-CR 0759, NSMT-Cr 9621; cb 117.8 mm), 1 ♂ (URM-CR 0757; cb 131.0 mm), 1 ♀ (URM-CR 0758; cb 141.2 mm), 4-V-1984.

*Remarks.* This species is uniformly yellowish brown or sometimes mottled with many purplish blotches on the carapace, being characterized by the unarmed clypeiform expansion at each side.

This species is widely distributed in the Indo-West Pacific from Sagami Bay in Japan and the Hawaiian Islands through New Caledonia and the Malay Archipelago to the east coast of Africa.

#### *Calappa capellonis* Laurie, 1906

OKINAWA. Nakagusuku Bay, 15–20 m deep.—1 ♀ (URM-CR 1105, NSMT-Cr 9622; cb 57.8 mm), 10-VI-1987.

*Remarks.* This species was originally described as the variety of *Calappa gallus* (Herbst) by Laurie [5], but the differences in armature of the carapacial dorsal surface and clypeiform expansions enumerated by Sakai [6, 7] and Takeda and Koyama [8] warrant its specific distinction from *C. gallus*.

This species is known only from Sri Lanka (type locality), and the Kii Peninsula, Kagoshima and Okinawa in Japan.

#### *Calappa gallus* (Herbst, 1803)

OKINAWA. Nakagusuku Bay.—1 ♀ (URM-CR 0083, NSMT-Cr 9623; cb 46.0 mm), 10-III-1986. Zampa-misaki.—1 ♀ (URM-CR 0080; cb 42.9 mm), VIII-1984. Yakata-katabaru.—1 ♂ (URM-CR 1429; cb 33.0 mm), 1987.

*Remarks.* This species is well figured by Klunzinger [9], Sakai [6, 7, 10], Rathbun [11], Barnard [12] and Monod [13].

This species is widely distributed in the whole Indo-West Pacific from Japan to the Red Sea and South Africa, the tropical Atlantic coast of Africa, and the western Atlantic from the Florida Keys to Bahia, Brazil. Such distribution pattern is quite unusual in the shallow-water crabs, so that the geographic speciation in these respective areas is to be confirmed with current knowledge of identification.

#### *Calappa hepatica* (Linnaeus, 1758)

OKINAWA. Manza beach.—1 ♀ (URM-CR 0076; cb 69.0 mm), 31-V-1985.

IRIOMOTE. Amitori Bay.—1 young ♂, 1 ♀ (URM-CR 0077; cb 30.3 and 55.3 mm), 1 young ♂ (URM-CR 0079; cb 32.5 mm), 16-VIII-1985.

**Remarks.** This is the most commonest species in the genus *Calappa* and well figured by Sakai [6, 7], being widely distributed in the whole Indo-West Pacific.

*Calappa yamasitae* Sakai from Japan described in 1980 [14] is the closest congener of this species, but according to the original description, distinguished by the following features: 1) Low protuberances of good size tipped each with a small tubercle are on the anterior two thirds of the carapacial dorsal surface, and the posterior third is tuberculate and granulated. 2) The front consists of two median obtuse teeth separated medially by an U-shaped sinus, each tooth bearing a subdistal tooth on its outer border. 3) The hepatic margin is gently turned into the clypeiform expansion of the branchial region without distinct constriction. 4) In both sexes the terminal abdominal tergum is broadly triangular in outline, not narrowed distally.

#### *Calappa lophos* (Herbst, 1782)

OKINAWA. Nakagusuku Bay.—1 ♂ (URM-CR 0754, NSMT-Cr 9624; cb 123.7 mm, cl 79.4 mm), 3-XII-1984; 1 ♀ (URM-CR 0073; cb 43.5 mm, cl 31.3 mm), 14-VI-1985; 1 ♀ (URM-CR 0071; cb 60.0 mm, cl 42.4 mm), 3-VII-1985; 1 ♀ (URM-CR 0072; cb 61.2 mm, cl 44.8 mm), 15-IV-1986; 1 ♀ (URM-CR 0070; cb 61.0 mm, cl 43.0 mm), 6-V-1986.

**Remarks.** This species is characteristic in its color pattern in the adult which is distinct even in spirit, being figured by de Haan [15], Sakai [6, 7, 10], Stephensen [16] and Barnard [12]. As mentioned by Alcock [17] and figured by Sakai [6], in the young the carapace is traversed by dark-colored longitudinal lines and marked with a pair of large ocelli in its posterior third.

This species is rather common in the sandy bottom, ranging from Japan through Sulawesi, India and the Persian Gulf to the east coast of Africa.

#### *Calappa philargius* (Linnaeus, 1758)

OKINAWA. Nakagusuku Bay, 15–20 m deep.—1 ♂ (URM-CR 0749, NSMT-Cr 9625; cb

112.0 mm), 12-XII-1984; 1 ♂ (URM-CR 0069; cb 58.8 mm), 13-V-1985; 1 ♂ (URM-CR 0068; cb 52.5 mm), 24-IX-1985; 1 ♂ (URM-CR 1161; cb 59.0 mm), 10-VI-1987.

**Remarks.** This species is characteristic in having a chocolate-brown band surrounding the orbit at each side, with a large spot each on the outer surface of the chelipedal carpus and palm. In its general shape it is close to *C. lophos* (Herbst), but the margin of the clypeiform expansions of both sides and the posterior border of the carapace are armed with much sharper teeth, as figured by de Haan [15], Shen [18], Sakai [6, 7, 10] and Guinot [19]. In *C. dumortieri* Guinot [19] from the Red Sea these teeth are further salient and rather tuberculated.

The geographical distribution is wide in the Indo-West Pacific from Japan through the Malay Archipelago and the Andaman Sea, Western Australia and the Persian Gulf to the Red Sea.

#### *Calappa quadrimaculata* sp. nov. (Figs. 1–4)

OKINAWA. Nakagusuku Bay.—1 ♂, paratype (URM-CR 0751; cb 67.5 mm, cl 41.3 mm), 17-XII-1984; 1 ♂, paratype (URM-CR 0752; cb 76.3 mm, cl 48.0 mm), 1 ♂, holotype (URM-CR 0753, NSMT-Cr 9626; cb 76.6 mm, cl 47.4 mm), 11-XII-1984; 1 ♂, paratype (URM-CR 0074; cb 72.2 mm, cl 44.8 mm), 01-XI-1985; 1 ♂, paratype (URM-CR 0084, NSMT-Cr 9627; cb 70.4 mm, cl 43.5 mm), 25-XII-1985.

TAIWAN. Tong-Kang, Ping-Tong County.—3 ♂ ♂, paratypes (NSMT-Cr 9628; cb 72.0 mm, cl 45.8 mm–cb 73.6 mm, cl 46.4 mm–cb 78.0 mm, cl 48.2 mm), 15-VII-1989.

**Description.** Typical of *Calappa*, with well developed clypeiform expansion at each side. Carapace strongly convex fore and aft, especially for its posterior part; its dorsal surface shining, but uneven with a pair of submedian deep furrow bordering mesogastric, cardiac and intestinal regions and with several linear shallow furrows on each branchial region; protogastric regions of both sides with 2 transverse rows of 4 blunt protuberances, each hepatic region with 2 protuberances, mesogastric region with 1, and each branchial region with 1 in a

line with mesogastric protuberance and 2 behind hepatic protuberances; frontorbital region in front of hepatic and protogastric protuberances thickly covered with microscopical vesicular granules; posterior surface on and around intestinal region

sparsely covered with frosted minute granules along posterior margin of carapace. Front deeply cleft in a shape of V; lower and upper edges of lateral margin obtusely angulated. Supraorbital margin rather strongly raised, with 2 closed

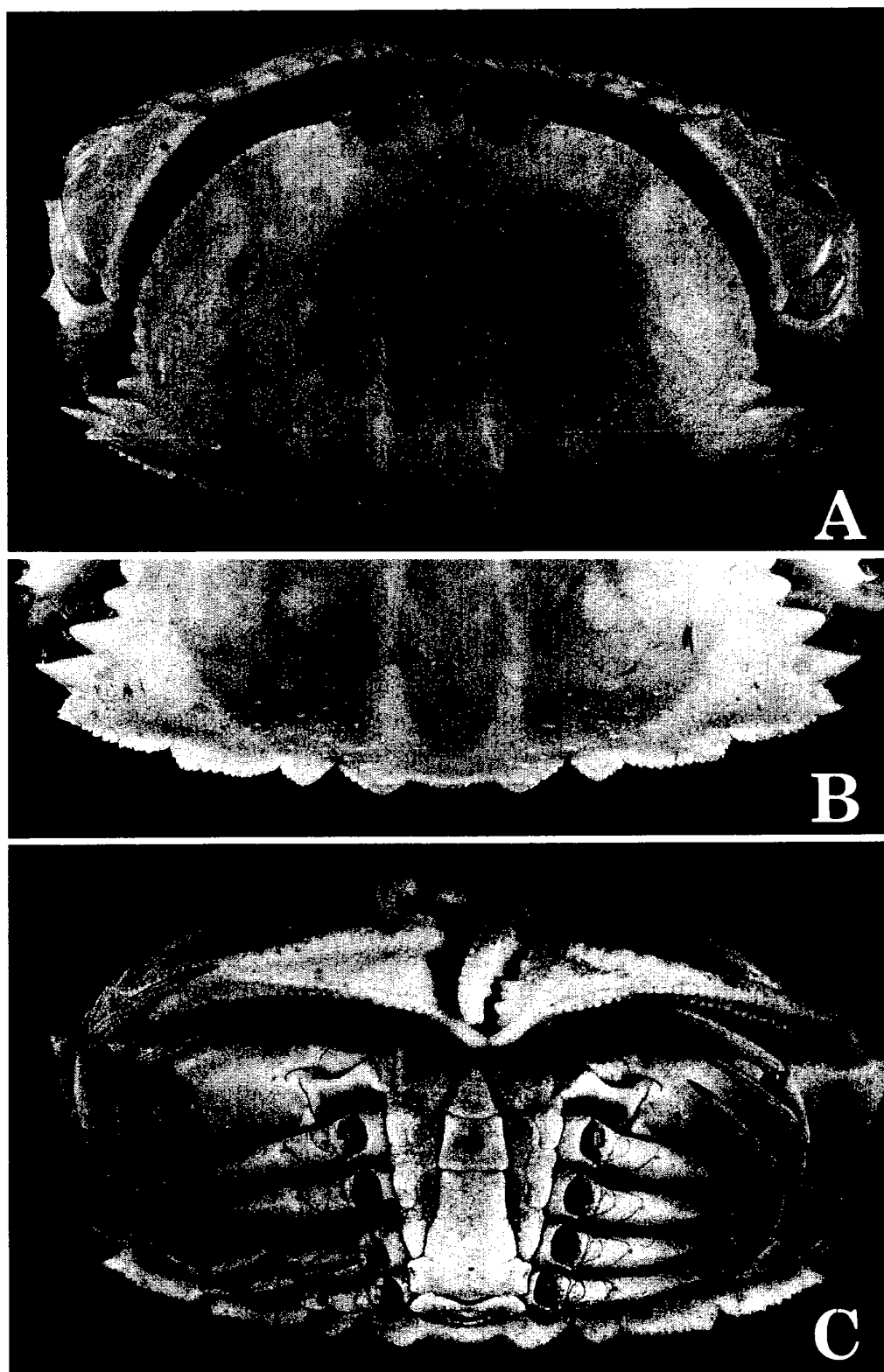


FIG. 1. *Calappa quadrimaculata* sp. nov., ♂, holotype (URM-CR 0753, NSMT-Cr 9626; cb 76.6 mm).

fissured on its outer half; its inner edge produced as a small tubercle separated from upper angle of front. Anterolateral margin of carapace gently convex, with 12 or 13 lobate teeth which are close together; first 4 or 5 teeth each with some minute granules of same size along margins, but posterior teeth except for the last with a median main granule and 2 accessory granules each on anterior and posterior slopes; clypeiform expansion well developed, with 4 strong teeth; first 2 obtusely angulated, and last 2 sharply pointed, end at same level; posterior margin of last tooth more or less serrulated with several granules, forming first lobe

of posterior margin of carapace; second lobe also serrulated along its whole margin, as wide as first lobe, obtusely angulated near lateral end; third lobe triangular, obtusely angulated at its apex, about half as wide as second lobe; median lobe weakly convex behind intestinal region along its central 1/3, with a triangular lobe at each side; apex of this lateral lobe obtuse, exceeding the level of median lobe and also that of third lobe.

Distal margin of chelipedal merus cut into 4 lobes, fringed with long hairs; median 2 lobes about 1/2 as wide as proximal and distal lobes; distal lobe sharply pointed distally, and subdistal

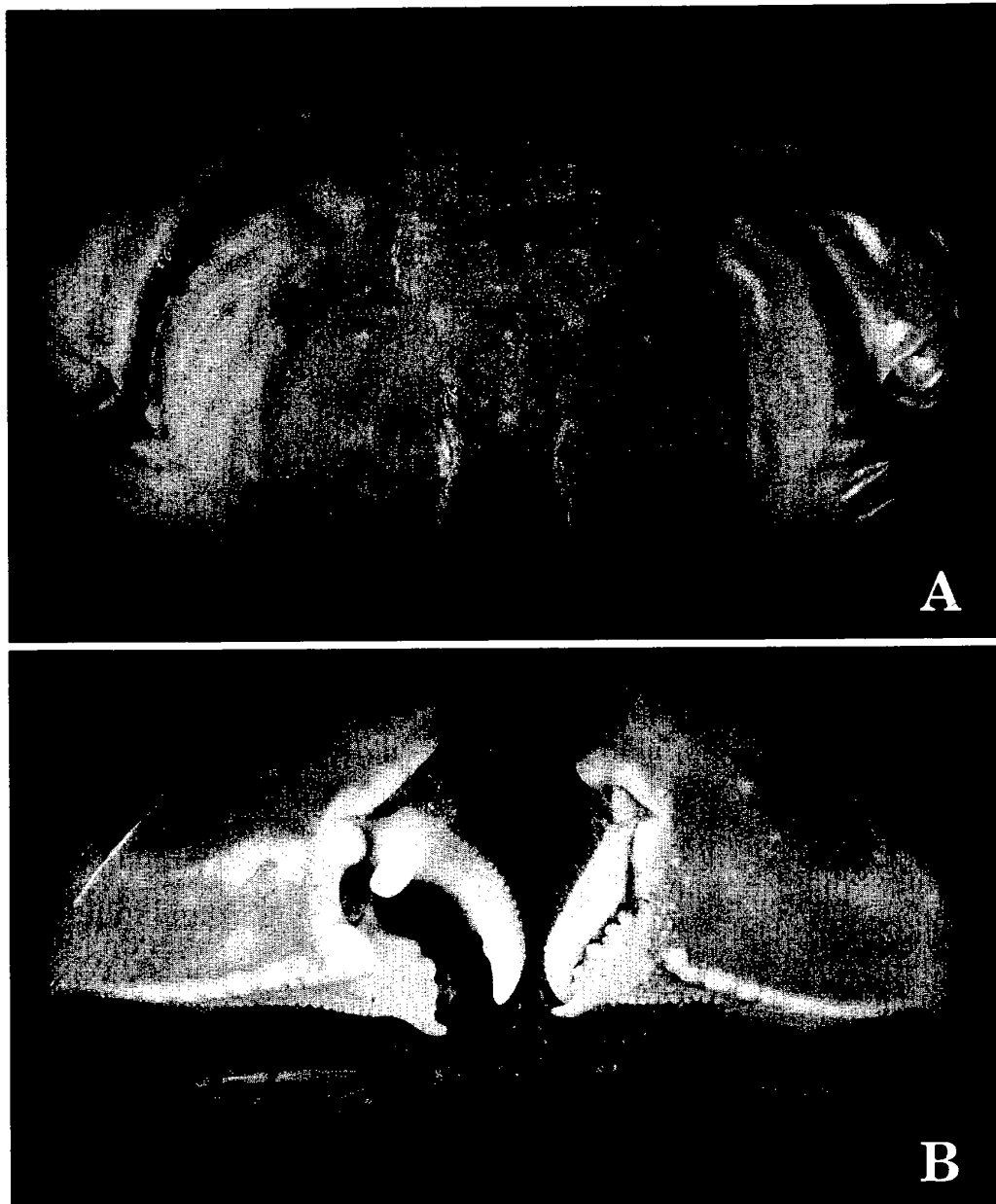


FIG. 2. *Calappa quadrimaculata* sp. nov., ♂, paratype (URM-CR 0074; cb 72.2 mm).

lobe with a spine at its median part; carpus and palm smooth and shining; upper margin of palm cut into 9 teeth, the first and the last of which are with pale brownish fringe.

**Etymology.** The species name, *quadrимaculata*, is referred to four ocelli of the carapace, which are somewhat variable in size, but always distinct.

**Remarks.** At a glance the new species is readily distinguished from the known species by the different color pattern. The basic color patterns of

the carapace and chelipeds are individually constant in the *Calappa* species and kept so long even in spirit, being one of the effective clues to distinguish the species.

The new species is without doubt most close to *Calappa lophos* (Herbst) in the general formation of the carapace and chelipeds, but distinguished from it by the proportional difference of the carapace and the morphological difference of the posterior lobes of the carapace. The carapace of the new species is seemingly, but apparently, wider than that of *C. lophos*.

This proportional difference is indicated with the measurements given to both species; in five specimens of *C. lophos* examined, the mean ratio of the carapace breadth to length is 1.43, while in eight specimens of the new species the ratio varies from 1.57 to 1.63 (mean 1.61). In addition, it is remarkable that in the new species the second posterior lobe of the carapace is almost equal to the first lobe in its width, but in *C. lophos* the second posterior lobe is at most  $2/3$  as wide as the first lobe.

Alcock [17] doubtfully synonymized *Calappa guerini* de Brito Capello with *C. lophos*. According to its original description and figure [20], it differs from *C. lophos* by having the sharply toothed innermost pair of the posterior lobes of

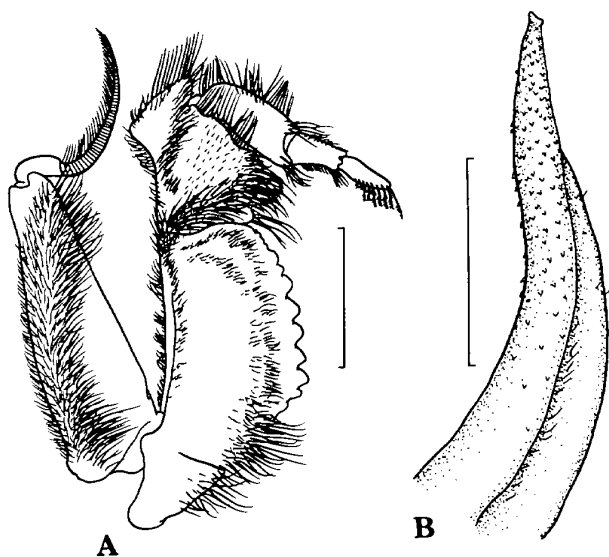


FIG. 3. *Calappa quadrимaculata* sp. nov., third maxilliped (A) and first pleopod (B) of ♂, paratype (URM-CR 0074). Scales=5 mm for A, 1 mm for B.

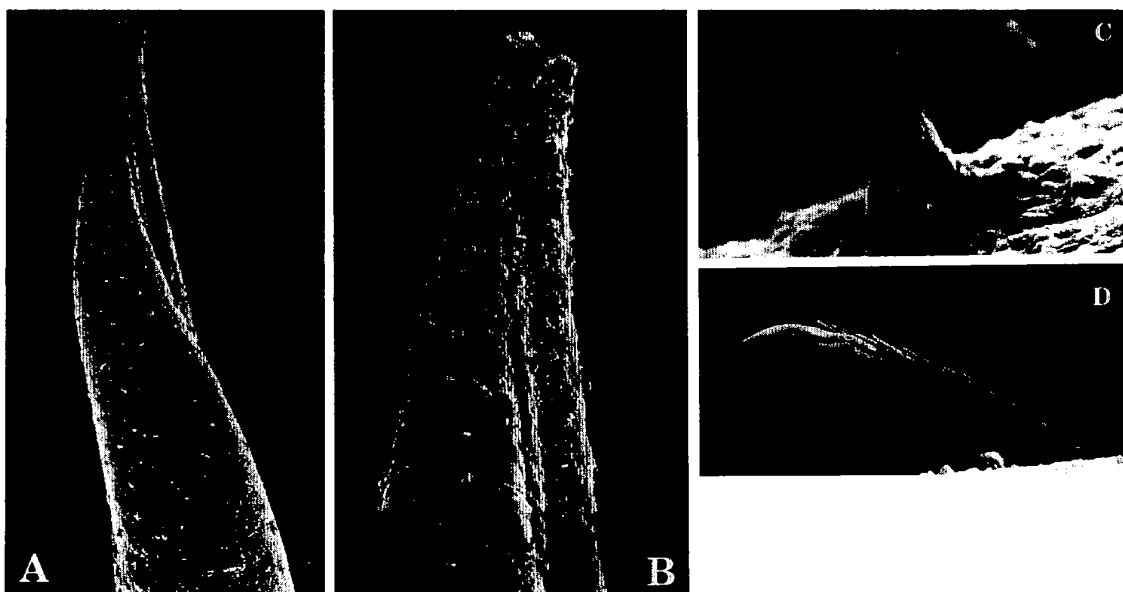


FIG. 4. *Calappa quatrimaculata* sp. nov., first pleopod of ♂, paratype (URM-CR 0074). A, distal fourth; B, distal part, further enlarged; C, one of tubercles dispersed on shaft; D, one of sensory hairs arranged in a line along seam.

TABLE 1. Japanese species of the genus *Calappa*

Species	Distribution	Foreign loc.
** <i>C. bicornis</i> Miers, 1884	Kii Penin. & Tosa Bay	W. Indian Ocean
* <i>C. calappa</i> (Linnaeus, 1758)	Sagami Bay to Ryukyus	Indo-W. Pacific
* <i>C. capellonis</i> Laurie, 1906	Kii Penin. to Ryukyus	Sri Lanka
* <i>C. gallus</i> (Herbst, 1785)	Sagami Bay to Ryukyus	Cosmopolitan
* <i>C. hepatica</i> (Linnaeus, 1758)	Sagami Bay to Ryukyus	Indo-W. Pacific
<i>C. japonica</i> Ortman, 1892	Sagami Bay to Kyushu	Indian Ocean
** <i>C. lophos</i> (Herbst, 1782)	Tokyo Bay to Kyushu	Indo-W. Pacific
** <i>C. philargius</i> (Linnaeus, 1758)	Tokyo Bay to Kyushu	Indo-W. Pacific
<i>C. pustulosa</i> Alcock, 1896	Sagami Bay to Tosa Bay	India
** <i>C. quadrimaculata</i> sp. nov.	Okinawa	Taiwan
** <i>C. terraereginae</i> Ward, 1936	Korean Channel	Australia
<i>C. yamasitae</i> Sakai, 1980	Kii Penin.	

Four species with an asterisk have hitherto been known not only from the Japanese mainland, but also from the Ryukyu Islands. Five species with two asterisks including a new species were newly added to the carcinological fauna of the Ryukyu Islands.

the carapace. There is no subsequent record of the species or discussion on its identity, and thus it is not always sure at present whether Alcock's synonymization is justified or not. However, at least, *C. guerini* is very close to and nearly identical with *C. lophos*, and the new species is separated from this doubtful species also by the different contour and armature of the carapace.

#### *Calappa terraereginae* Ward, 1936

OKINAWA. Nakagusuku Bay, 15–20 m deep.—1 ♂ (URM-CR 0088, NSMT-Cr 0629; cb 50.3 mm), 21-VI-1985; 1 ♂ (URM-CR 1162; cb 53.0 mm), 10-VI-1987.

**Remarks.** This species is only known by Ward [21], Sakai [6, 7] and Tyndale-Biscoe and George [22] from Lindeman Island off Queensland and Western Australia, and from off Cheju Island in the Korean Channel. The general formation of the carapace much resembles that of *C. lophos* (Herbst), but the carapace is slightly narrower, with more strongly arched anterolateral borders of the carapace, the teeth of the clypeiform expansion are rather triangular in dorsal view and not so sharp as in *C. lophos*, and the posterior border of the carapace is pronouncedly produced beyond the posterior border of the clypeiform expansion.

#### GEOGRAPHICAL NOTES

The genus *Calappa* is composed of 1 cosmopolitan, 15 Indo–West Pacific, 3 East Atlantic and 9 West Atlantic species. As enumerated in Table 1, the species known from Japanese waters are 12 including the new species described in the present paper. Four of them have hitherto been recorded not only from the Japanese mainland, but also from the Ryukyu Islands. In the present paper 4 known species were newly added to the carcinological fauna of the Ryukyu Islands.

Both of 2 species unrecorded from the Ryukyu Islands, *Calappa japonica* and *C. pustulosa*, are known from the Japanese mainland and Indian Ocean without the intervening localities. These two species are the deeper-water inhabitants than most of the other species, ranging bathymetrically from ca. 50 to 200 m. Therefore it may be possible to conclude that the absence of these two species from the Ryukyu Islands and the Southeast Asia is not due to the topographical condition, but to the insufficient operation of collecting the samples at the continental shelf.

*Calappa bicornis*, *C. capellonis* and *C. terraereginae* are also known only from Japan and the distant localities, viz., the western Indian Ocean, Sri Lanka and Australia, respectively, but it is reasonable that in due time they will be recorded

from the intervening localities. *C. gallus* is, as noted in the text, peculiar in its worldwide distribution.

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